FLUID PUMP AND MOTOR

Technical Field

The present invention relates to a fluid pump and motor, and more particularly, to a rotary fluid pump and motor.

Background Art

A fluid pump is a device that sucks and discharges a fluid through rotation of a shaft thereof by use of a driving unit, and a fluid motor is a device that receives fluid discharged from a pump and causes the shaft to rotate. A fluid pump and fluid motor are generally the same in view of their structures.

Related art fluid pumps are classified into vane pumps with sliding parts, gear pumps with two engaging gears, screw pumps and the like. Among them, the vane pump is often utilized because its structure is relatively simple. However, the related art vane pump should be configured such that its vane can come in and out of a rotor. Further, the vane pump has the following structural problems. That is, vibration may be produced in the vane pump because its rotating shaft is eccentric, and the bearings may be easily damaged due to the unbalanced load applied to the rotating shaft. Furthermore, pulsation may be produced because fluid is not continuously discharged from the vane pump.

Korean Patent No. 315954 discloses a pump having a structure different from that of the related art rotary pump. This pump comprises a hermetic container with suction and discharge tubes; a transmission mechanism which is installed in the hermetic container to generate a driving force; a cylinder assembly which defines an internal space and includes a plurality of suction and discharge passages communicating with the internal space; a rotating shaft which is coupled to a rotor of the transmission mechanism and penetrates through the center of the cylinder assembly; a partition plate which is coupled to the rotating shaft within the cylindrical assembly to partition the internal space into first and second spaces; vanes which are fitted through the cylinder assembly, resiliently supported such that they are always brought into contact with both

sides of the partition plate and move to switch the first and second spaces into suction and discharge regions, respectively; and an opening/closing means which discharges fluid compressed in compressing regions of the first and second spaces while opening and closing the discharge passage of the cylinder assembly. However, the pump disclosed in the Korean Patent No. 315954 has the problems in that the amount of discharge fluid is limited because a single space defined at one side of the partition plate becomes a compressing space, and pulsation may be produced because the width of the compressing region and thus the amount of discharge fluid varies over time. Further, since the opening/closing means (discharge valve) for discharging fluid is essentially provided, it is difficult to utilize the pump as a motor.

Summary of Invention

An object of the present invention is to provide a rotary fluid pump that is configured to include a vane and not to be eccentric. Another object of the present invention is to provide a rotary fluid pump with a simple vane that need not move in and out of a rotor. A further object of the present invention is to provide a rotary fluid pump having an increased discharge amount. A still further object of the present invention is to provide a rotary fluid pump having reduced pulsation. A still further object of the present invention is to provide a rotary fluid pump that can also be used as a motor.

According to an aspect of the present invention, there is provided a fluid pump, comprising a rotating chamber which is defined by first and second opposite wall surfaces and a third cylindrical wall surface for connecting the first and second wall surfaces to each other; a rotor which rotates about a rotating axis passing through the centers of the first and second wall surfaces within the rotating chamber and includes a hub with an outer circumferential surface and a vane protruding radially outward from the outer circumferential surface of the hub and having an outward radial tip that is slidably brought into close contact with the third wall surface of the rotating chamber; and a pair of blocking walls which cooperate with the vane and linearly move upon rotation of the rotor, and each of which has an opposite edge facing each other in such a

manner that the opposite edges of the blocking walls are slidably brought into close contact with both side surfaces, and the other edges of the blocking walls adjacent the opposite edges are slidably brought into close contact with the outer circumferential surface of the hub of the rotor. The vane further includes a leading end which is slidably brought into close contact with the first wall surface of the rotating chamber, a trailing end which is slidably brought into close contact with the second wall surface of the rotating chamber and inclines for connecting the leading and trailing ends. A suction port for suction of a fluid and a discharge port for discharge of the fluid are provided at both positions adjacent to the pair of the blocking walls which are interposed between the ports.

The pair of the blocking walls may be formed integrally with each other.

The third wall surface of the rotating chamber may be provided with suction grooves which are positioned adjacent to the pair of the blocking walls and connected to the suction ports to connect both spaces separated by the vane to each other, and discharge grooves which are positioned adjacent to the pair of the blocking walls and connected to the discharge ports to connect the both spaces separated by the vane to each other.

The leading and trailing ends of the vane may be formed to be brought into surface contact with the first and second wall surfaces of the rotating chamber, and the width of the radial tip of each of the leading and trailing ends of the vane may be formed to be larger than a maximum distance between the corresponding suction and discharge grooves.

The fluid pump may further comprise first and second pressing plates which define the first and second wall surfaces of the rotating chamber, linearly move along the rotating axis and are slidably brought into close contact with the leading and trailing ends of the vane by an external force.

The pressing plates may be urged toward the rotating chamber by the fluid on a high-pressure side.

The pressing plates may be urged toward the rotating chamber by an elastic member.

The fluid pump may further comprise a pressure-regulating device for regulating pressure of the fluid discharged from the discharge ports and supplied to a load side.

Preferably, the fluid discharged from the discharge ports flows toward a return passage communicating with a low-pressure side and a discharge passage communicating with the load side through first and second branched passages, respectively, and the pressure-regulating device includes a discharge amount regulating unit having a moving member for moving according to the pressure of the fluid in the discharge passage to open and close the first passage and a check valve provided in the second passage.

The pressure-regulating device may further comprise an elastic member for urging the moving member in a direction opposite to a direction in which the pressure of the fluid in the discharge passage is exerted on the moving member.

Preferably, two leading ends, two tailing ends and two pairs of blocking walls are provided, and suction and discharge grooves are provided adjacent the two pairs of the blocking walls while being separated by the two pairs of blocking walls.

The fluid pump may further comprise a pressure-regulating device for regulating pressure of the fluid discharged from the discharge ports and supplied to a load side.

Preferably, the fluid discharged through the two discharge ports provided at the discharge grooves flows toward first and second passages connected to a return passage communicating with a low-pressure side and toward third and fourth passages connected to a discharge passage communicating with a load side, and the pressure-regulating device includes a discharge amount regulating unit having a moving member for moving according to the pressure of the fluid in the discharge passage to open and close the first or second passage and first and second check valves provided in the third and fourth passages, respectively.

The pressure-regulating device may further comprise an elastic member for urging the moving member in a direction opposite to a direction in which the pressure of the fluid in the discharge passage is exerted on the moving member.

The pressure-regulating device may further include an accumulating portion.

The accumulating portion may include a moving member for moving by receiving the pressure of the fluid in the discharge passage and an elastic member for urging the moving member in a direction opposite to a direction in which the pressure of the fluid is exerted on the moving member.

The pair of blocking walls may have contact members that are brought into contact with both side surfaces of the vane, and each of the pair of blocking walls may be provided with a receiving groove for receiving the contact member and a passage hole for causing the receiving groove to communicate with a discharge side.

According to another aspect of the present invention, there is provided a fluid motor, comprising a rotating chamber which is defined by first and second opposite wall surfaces and a third cylindrical wall surface for connecting the first and second wall surfaces to each other; a rotor which rotates about a rotating axis passing through the centers of the first and second wall surfaces within the rotating chamber, and includes a hub with an outer circumferential surface and a vane protruding radially outward from the outer circumferential surface of the hub and having an outward radial tip that is slidably brought into close contact with the third wall surface of the rotating chamber; and a pair of blocking walls which cooperate with the vane and linearly move upon rotation of the rotor, each of the blocking walls having an opposite edge facing each other in such a manner that the opposite edges of the blocking walls are slidably brought into close contact with both side surfaces and other edges of the blocking walls adjacent the opposite edges are slidably brought into close contact with the outer circumferential surface of the hub of the rotor. The vane further includes a leading end which is slidably brought into close contact with the first wall surface of the rotating chamber, a trailing end which is slidably brought into close contact with the second wall surface of the rotating chamber and inclines for connecting the leading and trailing ends. An inlet port for inflow of a fluid and an outlet port for outflow of the fluid are provided at both positions adjacent to the pair of the blocking walls which are interposed between the inlet and outlet ports.

The pair of the blocking walls may be formed integrally with each other.

The third wall surface of the rotating chamber may be provided with inflow grooves which are positioned adjacent to the pair of the blocking walls and connected to the inlet ports to connect both spaces separated by the vane to each other, and outflow grooves which are positioned adjacent to the pair of the blocking walls and connected to the outlet ports to connect the both spaces separated by the vane to each other.

The leading and trailing ends of the vane may be formed to be brought into surface contact with the first and second wall surfaces of the rotating chamber, and the width of a radial tip of each of the leading and trailing ends of the vane may be formed to be larger than a maximum distance between the corresponding suction and discharge grooves.

The fluid motor may further comprise first and second pressing plates which form the first and second wall surfaces of the rotating chamber, linearly move along the rotating axis and are brought into close contact with the leading and trailing ends of the vane by an external force.

The pressing plates may be urged toward the rotating chamber by the fluid on a high-pressure side.

The pressing plates may be urged toward the rotating chamber by an elastic member.

Brief Description of Drawings

Fig. 1 is a perspective view of a fluid pump according to a first embodiment of the present invention in which the interior of a main body of the pump can be shown by cutting away a portion of a pump housing.

Fig. 2 is a sectional side view of the main body of Fig. 1.

Fig. 3 is a sectional view schematically illustrating the interior of the main body and a pressure-regulating device in a state where the amount of discharge fluid of the fluid pump shown in Fig. 1 is 100%, in which the housing of the main body has been cut perpendicular to a rotating shaft.

Fig. 4 is a sectional view of the main body of Fig. 3 taken along line A-A'.

Fig. 5 is a perspective view of a linear moving object of the main body shown in

Fig. 1.

Fig. 6 is a perspective view of a pressing plate of the main body shown in Fig. 1.

Fig. 7 is a perspective view of an opening/closing means of the pressure-regulating device shown in Fig. 3.

Fig. 8 (a) to (d) is a view of an unrolled rotor of the main body of Fig. 1 in which the rotor is shown together with the first and second blocking walls.

Fig. 9 is a sectional view schematically illustrating the interior of the main body and the pressure-regulating device in a state where the amount of discharge fluid of the fluid pump shown in Fig. 1 is 50%, in which the housing of the main body has been cut perpendicular to the rotating shaft.

Fig. 10 is a sectional view schematically illustrating the interior of the main body and the pressure-regulating device in a state where the amount of discharge fluid of the fluid pump shown in Fig. 1 is 0%, in which the housing of the main body has been cut perpendicular to the rotating shaft.

Fig. 11 is a perspective view of a fluid pump according to a second embodiment of the present invention in which the interior of the main body of the pump can be shown by cutting away a portion of a pump housing.

Fig. 12 is a sectional view schematically illustrating the interior of the main body and a pressure-regulating device in a state where the amount of discharge fluid of the fluid pump shown in Fig. 11 is 100%, in which the housing of the main body has been cut perpendicular to the rotating shaft.

Fig. 13 (a) to (d) is a view of an unrolled rotor of the main body of Fig. 11 in which the rotor is shown together with the first and second blocking walls.

Fig. 14 is a sectional view schematically illustrating the interior of the main body and the pressure-regulating device in a state where the amount of discharge fluid of the fluid pump shown in Fig. 11 is 0%, in which the housing of the main body has been cut perpendicular to the rotating shaft.

Fig. 15 is a perspective view of a main body of a fluid pump according to a third embodiment of the present invention.

Fig. 16 is a perspective view of the housing of the main body of Fig. 15 taken

along line C-C'.

Fig. 17 is an exploded perspective view of a linear moving object shown in Fig. 16, in which a central portion thereof is cut away such that the discharge side can be seen.

Best Mode for Carrying Out the Invention

Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings.

Figs. 1 to 10 are views related to a first embodiment of the present invention. Referring to Figs. 1 to 4, a fluid pump 10 includes a main body 19 and a pressure-regulating device 90. The main body 19 includes a housing 20, a rotor 30, a rotating shaft 40, first and second linear moving objects 50 and 60, and first and second pressing plates 70 and 80. A rotating axis 100 is the line extending along the axis of the rotating shaft 40. The housing 20 includes a cylindrical body portion 21, and first and second wing portions 28 and 29 positioned at both sides of the body portion 21. The body portion 21 includes first and second end walls 22 and 24, and a side wall 26 connecting the two end walls 22 and 24. The first and second end walls 22 and 24 are formed as a circular plate and face each other to be orthogonal to the rotating axis 100.

An internal space of the body portion 21 is divided into first and second pressing chambers 201 and 202 and a rotating chamber 23 by means of the first and second pressing plates 70 and 80 that are installed to divide the internal space and to be orthogonal to the rotating axis 100. The first pressing chamber 201 is a space defined between the first end wall 22 and the first pressing plate 70, whereas the second pressing chamber 202 is a space defined between the second end wall 24 and the second pressing plate 80. The rotating chamber 23 is a space defined between the first and second plates 70 and 80. The rotating chamber 23 is defined by first and second opposite circular wall surfaces 231 and 232 and a third cylindrical wall surface 233 connecting the first and second wall surfaces 231 and 232. The first and second wall surfaces 231 and 232 become surfaces facing the first and second pressing plates 70 and 80, respectively, whereas the third wall surface 233 becomes a portion defined on the inner

surface of the side wall 26 of the body portion 21 of the housing 20 between the first and second pressing plates 70 and 80. Two leading ends 341 and 345 of a vane 34 of the rotor 30 to be explained later are brought into close contact with the first wall surface 231 in such a manner that they can be slid while coming into surface contact with the first wall surface, whereas two trailing ends 343 and 347 of the vane 34 are brought into close contact with the second wall surface 232 in such a manner that they can be slid while coming into surface contact with the second wall surface. A radial tip of the vane 34 is slidably brought into close contact with the third wall surface 233.

The rotating shaft 40 extending along the rotating axis 100 passes through the centers of the two end walls 22 and 24 of the body portion 21. The rotating shaft 40 is rotatably supported by bearings 42 and 44 installed at the centers of the two end walls 22 and 24. The rotating shaft 40 extends along the rotating axis 100 beyond the first end wall 22 and is connected to a driving unit (not shown).

Referring to Figs. 1 and 3, a first suction groove 261, a first discharge groove 262, a second suction groove 263 and a second discharge groove 264 are sequentially disposed on the third wall surface 233 of the rotating chamber 23. Each of the grooves 261, 262, 263 and 264 extends in parallel with the rotating axis 100. The first and second suction grooves 261 and 263 are arranged to be symmetrical with each other about the rotating axis 100. The first and second discharge grooves 262 and 264 are also arranged to be symmetrical with each other about the rotating axis 100. The first suction groove 261 and the second discharge groove 264 are positioned adjacent to each other, whereas the first discharge groove 262 and the second suction groove 263 are positioned adjacent to each other. The first moving object 50 is positioned between the first suction groove 261 and the second discharge groove 264. Further, the second moving object 60 is positioned between the first discharge groove 262 and the second suction groove 263. First and second suction ports 2611 and 2631 are provided at given positions (e.g., the centers) on the first and second suction grooves 261 and 263, respectively. First and second suction tubes 15 and 17 are connected to the first and second suction ports 2611 and 2631, respectively. First and second discharge ports 2621 and 2641 are provided at given positions (e.g., the centers) on the first and second

discharge grooves 262 and 264, respectively. First and second discharge tubes 16 and 18 are connected to the first and second discharge ports 2621 and 2641, respectively. However, the present invention is not limited thereto. That is, the first and second suction ports 2611 and 2631 and the first and second discharge ports 2621 and 2641 may be changed in view of their positions.

Referring to Figs. 1 to 4, the first wing portion 28 is formed to extend from the two end walls 22 and 24 toward the opposite directions in parallel with the rotating axis 100. Further, the first wing portion 28 is formed to extend inward and outward from the side wall 26 in a radial direction. Therefore, the first wing portion 28 has a sectional shape that is a thin rectangle standing upright along the radial direction of the rotating axis 100 but is not formed in a space where the body portion 21 is formed. The first wing portion 28 is provided with a first guide passage 281 along which the first moving object 50 is linearly moved. The sectional shape of the first guide passage 281 is the same as that of the first moving object 50. The first guide passage 281 extends from the two end walls 22 and 24 of the housing 20 in a direction parallel with the rotating axis 100 and also beyond the side wall 26 of the housing 20 in the radial direction of the rotating axis 100. The first suction groove 261 and the second discharge groove 264 are positioned adjacent to each other with the first guide passage 281 interposed therebetween (See Figs. 3 and 4). Passage holes 282 are formed on both longitudinal ends of the first wing portion 28, respectively. The first guide passage 281 is vented with the outside through passage holes 282, and thus, the first linear moving object 50 can be smoothly moved within the first guide passage 281. A detailed description on the second wing portion 29 will be omitted herein since it is configured to be symmetrical with the first wing portion 29 about the rotating axis 100. The second linear moving object 60 is placed in a second guide passage 291 within the second wing portion 29, and the first discharge groove 262 and the second suction groove 263 are positioned adjacent to each other with the second guide passage 282 interposed therebetween.

Referring again to Figs. 1 to 4, the rotor 30 is placed in the rotating chamber 23 within the housing 20 and includes a cylindrical hub 32 coupled to the rotating shaft 40

and a vane 34 protruding from the hub 32 in a radial direction. Opposite ends of the hub 32 are slidably brought into close contact with the first and second wall surfaces 231 and 232 in the rotating chamber 23, respectively. The rotating shaft 40 passes through the centers of the opposite ends of the hub 32. The radius of the hub 32 is sized such that its outer circumferential surface 321 is slidably brought into close contact with edges 541 and 561 of first and second blocking walls 54 and 56 of the first linear moving object 50 and edges 641 and 661 of first and second blocking walls 64 and 66 of the second linear moving object 60. Fluid flows through a space defined between the outer circumferential surface 321 of the hub 32 and the third wall surface 233 of the rotating chamber 23.

Referring again to Figs. 1 to 4, the vane 34 takes the shape of a wall protruding from the outer circumferential surface 321 of the hub 32 in a radial direction and surrounds the outer circumferential surface 321 of the hub 32 such that both side surfaces thereof face the first and second wall surfaces 231 and 232 of the rotating chamber 23, respectively. Herein, one of the side surfaces 340 and 349 facing the first wall surface 231 of the rotating chamber 23 is referred to as a first surface 340, whereas the other of the two surfaces facing the second wall surface 232 of the rotating chamber 23 is referred to as a second surface 349.

Referring to Figs. 1 to 4 together with Fig. 8 (a) in which a rotor 30 is unrolled and shown, the vane 34 includes the two leading ends 341 and 345 which are symmetrical with each other about the rotating axis 100 and have a flat surface with a predetermined width (an angular width) perpendicular to the rotating axis such that it can be slidably brought into surface contact with the first wall surface 231 of the rotating chamber 23, the two trailing ends 343 and 347 which are symmetrical with each other about the rotating axis 100 and have a flat surface with a predetermined width (an angular width) perpendicular to the rotating axis such that it can be slidably brought into surface contact with the second wall surface 232 of the rotating chamber 23, and four inclines 342, 344, 246 and 348 which are inclined with respect to the rotating axis 100 and connect the leading and trailing ends 341, 343, 345 and347. The vane 34 is configured in such a manner that the leading end 341, the incline 342, the trailing end

343, the incline 344, the leading end 345, the incline 346, the trailing end 347 and the incline 348 are smoothly connected with one another sequentially in a circumferential direction of the rotating axis 100. The outward radial tip of the vane 34 in a radial direction about the rotating axis 100 is slidably brought into close contact with the third surface 233 of the rotating chamber 23. Two opposite edges 542 and 562 of the two blocking walls 54 and 56 of the first linear moving object 50 and two opposite edges 642 and 662 of the two blocking walls 64 and 66 of the second linear moving object 60, both of which will be described later, are slidably brought into close contact with the first and second surfaces 340 and 349 of the vane 34. The thickness of the vane 34 is determined such that the two opposite edges 542 and 562 of the two blocking walls 54 and 56 of the first linear moving object 50 and the two opposite edges 642 and 662 of the two blocking walls 64 and 66 of the second linear moving object 60 are always slidably brought into close contact with the first and second surfaces 340 and 349 when the rotor 30 is rotated. Preferably, the thickness of the vane 34 is determined such that a distance between the first and second surfaces 340 and 349 in a direction in which the first and second linear moving objects 50 and 60 extend is substantially kept constant.

Due to the configuration of the vane 34, the space defined between the outer circumferential surface 321 of the hub 32 of the rotor 30 and the third wall surface 233 of the rotating chamber 23 is divided into first and third spaces 11 and 13, which are formed by the first wall surface 231 of the rotating chamber 23 and the first surface 340 of the vane 34, and second and fourth spaces 12 and 14, which are formed by the second wall surface 232 of the rotating chamber 23 and the second surface 349 of the vane 34. The width of the radial tips (angular width) of the leading ends 341 and 345 and trailing ends 343 and 347 is formed to be greater than the maximum angular distance between the first suction groove 261 and the second discharge groove 264 (i.e., an angular distance from the farthest end of the first suction groove to the farthest end of the second discharge groove) and the maximum angular distance between the second suction groove 263 and the first discharge groove 262.

Referring to Figs. 1 to 5, the first linear moving object 50 takes the shape of an elongated straight thin bar and includes a base 52 located at a relatively outer portion in

a radial direction of the rotating axis 100 and the first and second blocking walls 54 and 56 standing upright from the base 52 in an inward radial direction of the rotating axis 100. The first and second blocking walls 54 and 56 define a pair of blocking walls. The height of the first and second blocking walls 54 and 56 is the same as that of the vane 34 of the rotor 30. The inner edges 541 and 561 of the first and second blocking walls 54 and 56 in a radial direction of the rotating axis 100 taper off and slidably brought into close contact with the outer circumferential surface 321 of the hub 32 of the rotor 30. Accordingly, friction between the hub 32 of the rotor 30 and the first and second blocking walls 54 and 56 can be reduced. The opposite edges 542 and 562 of the first and second blocking walls 54 and 56 also taper off and slidably brought into close contact with the first and second surfaces 340 and 349 of the vane 34 of the rotor 30. An inner edge 521 of the base 52 between the first and second blocking walls 54 and 56 is slidably brought into close contact with the outward radial tip of the vane 34. The first linear moving object 50 is placed in the first guide passage 281 of the housing 20 and linearly moved along the first guide passage 281 by means of the vane 34 as the rotor 30 is rotated. The second linear moving object 60 is configured to be symmetrical with the first linear moving object 50 and placed in the second guide passage 291 of the second wing portion 29. Therefore, the detailed description on the second linear moving object will be omitted herein.

As shown in Fig. 8 (a) in which the vane is unrolled, when the first and second linear moving objects 50 and 60 are positioned at the inclines 342 and 346 of the vane 34, respectively (or when the objects are positioned at the other inclines 344 and 348), the first blocking wall 54 of the first linear moving object 50 divides the first space 11 into first and second subspaces 111 and 112 and blocks the two subspaces 111 and 112. Further, the second blocking wall 56 of the first linear moving object 50 divides the second space 12 into first and second subspaces 121 and 122 and blocks the two subspaces 121 and 122. Similarly, the first blocking wall 64 of the second linear moving object 60 divides the third space 13 into first and second subspaces 131 and 132 and blocks the two subspaces 131 and 132. Further, the second blocking wall 66 of the second linear moving object 60 divides the second space 14 into first and second

subspaces 141 and 142 and blocks the two subspaces 141 and 142. On the other hand, as shown in Fig. 8 (a) to (d), when the first and second linear moving objects 50 and 60 are positioned at the leading ends 341 and 345 of the vane 34, respectively, only the second and fourth space 12 and 14 are in a state where they are divided into two subspaces by means of the second blocking walls 56 and 66 of the first and second linear moving objects 50 and 60, respectively. Although not shown in the figure, it can be easily understood by those skilled in the art that when the first and second linear moving objects 50 and 60 are positioned at the two trailing ends 343 and 347 of the vane 34, respectively, only the first and third spaces 11 and 13 are divided into two subspace by means of the first and second blocking walls 54 and 64 of the first and second linear moving objects 50 and 60, respectively.

Referring to Figs. 1, 2, 4 and 7, the first pressing plate 70 takes the shape of a circular plate, and includes a circular through-hole 71 formed at the center thereof, first and second passage slits 72 and 74 extending from an outer periphery thereof toward the center thereof, and passage holes 76 and 78 formed adjacent to the passage slits 72 and 74. The outer periphery 701 of the first pressing plate 70 is slidably brought into close contact with the side wall 26 of the housing 20. The rotating shaft 40 passes through the central hole 71. The first and second passage slits 72 and 74 are formed to be symmetrical with each other with respect to the central hole 71. Each of the two passage slits 72 and 74 has the same shape as the sectional shape of the first blocking wall 54 or 64 of the first or second linear moving object 50 or 60. The two first blocking walls 54 and 64 of the first and second linear moving objects 50 and 60 are slidably fitted into the two passage slits 72 and 74, respectively. The two passage holes 76 and 78 are generally symmetrical with each other about the rotating axis 100 and positioned at the discharge side of the rotating chamber. High-pressure fluid at the discharge side of the rotating chamber 23 is supplied to the first pressing chamber 201 through the two passage holes 76 and 78. A detailed description on the second pressing plate 80 will be omitted herein, because it has the same shape as the first pressing plate 70.

The two facing surfaces of the first and second pressing plates 70 and 80

become the first and second wall surfaces 231 and 232 of the rotating chamber 23. The high-pressure fluid in the first and second pressing chambers 201 and 202 exerts a force on the two wall surfaces to press the rotor 30 in the opposite direction. Although it has been described in this embodiment that the high-pressure fluid exerts a force on the first and second pressing plates 70 and 80 to press the rotor 30, the present invention is not limited thereto. It will be understood by those skilled in the art that the rotor may be pressed by an elastic member such as a compression coil spring.

Referring to Fig. 3, the pressure-regulating device 90 includes a discharge amount regulating unit 91 and a compressing unit 96 which are provided in a block 900. The discharge amount regulating unit 91 includes a moving member 92, an elastic member 93, and first and second check valves 94 and 95. The moving member 92 and elastic member 93 are received in a first receiving space 901. The first receiving space 901 is cylindrically shaped, and includes circular bottom and top ends 902 and 903 and a side wall 904 connecting the bottom and top ends 902 and 903. A first pressure supply passage 151 to be explained later, which is connected to a discharge passage 150 and transmits discharge fluid pressure to the moving member 92 connected to a load side, is connected to the bottom end 902. An extension shaft 924 of the moving member 92 to be explained later is inserted into the first pressure supply passage 151. A first passage hole 9033 connected to a seventh passage 107 to be explained later is formed on the top end 903. First and second inlets 9041 and 9042 connected to first and third passages 101 and 103 to be explained later are formed in the middle of the side wall 904. The first and second inlets 9041 and 9042 are positioned relatively close to the bottom and top ends 902 and 903, respectively. The side wall 904 is provided with first and second outlets 9043 and 9044 connected to fifth and sixth passages 105 and 106 to be explained later, respectively, at positions opposite to the first and second inlets 9041 and 9042. The side wall 904 is also provided with a second passage hole 9045 connected to an eighth passage 108 to be explained later at a position adjacent to the top end 903.

The discharge tube 16 extending from the main body 19 of the fluid pump 10 is branched off into the first and second passages 101 and 102. The first passage 101

communicates with the first receiving space 901 through the first inlet 9041, and the second passage 102 is connected with the discharge passage 150. The first check valve 94 is provided on the second passage 102 to prevent fluid from flowing in a reverse direction. The second discharge tube 18 extending from the main body 19 is branched off into the third and fourth passages 103 and 104. The third passage 103 communicates with the first receiving space 901 through the second inlet 9042, and the fourth passage 104 is connected with the discharge passage 150. The second check valve 95 is provided on the fourth passage 104 to prevent fluid from flowing in a reverse direction. Although the fifth and sixth passages 105 and 106 connected with the first and second outlets 9043 and 9044 of the first receiving space 901 are not shown, they are connected to a return passage 160 communicating with a low-pressure side such as a storage tank. The eighth passage 108 connects the second passage hole 9045 and the sixth passage 106. The seventh passage 107 connects the first passage hole 9033 and a third passage hole 9631 provided on the top end 963 of the second receiving space 961 of the compressing unit 96. Accordingly, the top ends of the first and second receiving spaces 901 and 961 are always connected to the low-pressure side.

Referring to Figs. 3 and 7, the moving member 92 includes an opening/closing portion 921, a connection post 922, a closing portion 923 and the extension shaft 924, which are provided sequentially from above. The opening/closing portion 921 is cylindrically shaped, and the radius of the opening/closing portion 921 is determined such that an outer circumferential surface 9211 can be slid on the side wall 904 of the first receiving space 901. The height of the opening/closing portion 921 is determined such that the outer circumferential surface 9211 can close both the first and second inlets 9041 and 9042 and the first and second outlets 9043 and 9044 which are provided on the side wall 904 of the first receiving space 901. The connection post 922 is cylindrically shaped, and the radius of the connection port 922 is less than that of the opening/closing portion 921 such that an outer circumferential surface 9221 is not brought into contact with the side wall 904 of the first receiving space 901. Further, the height of the connection post 922 is determined such that both the first and second inlets 9041 and 9042 and the first and second outlets 9043 and 9044, which are provided

on the side wall 904 of the first receiving space 901, can be positioned within an interval of the connection post 922 when the moving member 922 is moved to an uppermost position. The closing portion 923 takes the shape of a thin disc, and its radius is determined such that an outer circumferential surface 9231 can be slid on the side wall 904 of the first receiving space 901. The extension shaft 924 takes the shape of a thin circular rod, and its diameter is determined such that it can be tightly inserted into and slid along the first pressure supply passage 151 connected with the bottom 902 of the first receiving space 901. Fluid pressure in the discharge passage 150 is applied to the distal end of the extension shaft 924. Due to the fluid pressure applied to the distal end of the extension shaft 924, the moving member 92 moves upward. The moving member 92 can move vertically within the first receiving space 901. The elastic member 93 is a compression coil spring, and both ends thereof are coupled with the top end 903 of the first receiving space 901 and the upper end of the opening/closing portion 921 of the moving member 92. The elastic member 93 pushes the moving member 92 toward the bottom end 902 of the first receiving space 901. The moving member 92 is urged downward by means of the elastic member 93 such that when the closing portion 923 is brought into contact with the bottom end 902 of the first receiving space 901, the outer circumferential surface 9211 of the opening/closing portion 921 closes both the first and second inlets 9041 and 9042 and the first and second outlets 9043 and 9044, which are provided on the side wall 904 of the first receiving space 901.

Referring to Fig. 3, the compressing unit 96 includes a moving member 97 and an elastic member 98. The moving member 97 and elastic member 98 are received in the second receiving space 961. The second receiving space 961 is cylindrically shaped and includes circular bottom and top ends 962 and 963 and a side wall 964 connecting the bottom and top ends 962 and 963. A second pressure supply passage 152, which is connected to the discharge passage 150 and transmits discharge fluid pressure to the moving member 97, is connected to the bottom end 962. An extension shaft 972 of the moving member 97 to be explained later is inserted into the second pressure supply passage 152. A third passage hole 9631 connected to the seventh passage 107 is formed on the top end 963.

Referring again to Fig. 3, the moving member 97 includes a piston 971 and the extension shaft 972, which are provided sequentially from above. The piston 971 is cylindrically shaped, and its diameter is determined such that an outer circumferential surface 9711 can be slid on the side wall 964 of the second receiving space 961. The piston 971 can move vertically within the second receiving space 961. The extension shaft 972 is also cylindrically shaped and tightly inserted into and slid along the second pressure supply passage 152 connected with the bottom end 962 of the second receiving space 961. Fluid pressure in the discharge passage 150 is applied to a distal end of the extension shaft 972. The elastic member 98 is a compression coil spring, and both ends thereof are coupled with the top end 963 of the second receiving space 961 and the upper end of the piston 971 of the moving member 97. The elastic member 98 pushes the moving member 97 toward the bottom end 962 of the second receiving space 961.

Hereinafter, the operation of the fluid pump according to the first embodiment of the present invention will be described in detail with reference to Figs. 3, 8 (a) to (d), 9 and 10. First, the operating of the main body 19 is described with reference to Fig. 8 (a) to (d). Fig. 8 (a) to (d) shows an unrolled rotor 30. In the figure, the rotor 30 is shown as a solid line whereas the grooves 261, 262, 263 and 264, the suction ports 2611 and 2631 and the discharge ports 2621 and 2641 are shown as a dotted line. If the rotating shaft 40 is rotated clockwise by means of the driving unit (not shown) as shown in Fig. 1, the rotor 30 is also rotated clockwise. This rotation corresponds to a leftward linear motion of the unrolled rotor 30 shown in Fig. 8 (a). In Fig. 8 (a), the first and second linear moving objects 50 and 60 are placed on the two inclines 342 and 346 of the vane 34, respectively. Referring to Fig. 8 (a), the second subspaces 112 and 142 of the first and fourth spaces 11 and 14 communicate with each other through the first suction groove 261, the first subspaces 121 and 131 of the second and third spaces 12 and 13 communicate with each other through the first discharge groove 262, the second subspaces 122 and 132 of the second and third spaces 12 and 13 communicate with each other through the second suction groove 263, and the first subspaces 141 and 111 of the fourth and first spaces 14 and 11 communicate with each other through the second discharge groove 264. If the rotor 30 is rotated in such a state, the two subspaces 112

and 142 communicating with each other through the first suction groove 261 and the tow subspaces 122 and 132 communicating with each other through the second suction groove 263 are increased. Accordingly, fluid is sucked through the first and second suction ports 2611 and 2631. The sucked fluid is introduced into the respective subspaces 112, 142, 122 and 132 communicating with one another through the first and second suction grooves 261 and 263. At the same time, the two subspaces 121 and 131 communicating with each other through the first discharge groove 262 and the tow subspaces 141 and 111 communicating with each other through the second discharge groove 264 are decreased. Accordingly, the fluid in the subspaces 121, 131, 141 and 111 is discharged to the first and second discharge ports 2621 and 2641 through the first and second discharge grooves 262 and 264. Fig. 8 (b) shows a state where the first and second linear moving objects 50 and 60 reach the two leading ends 341 and 345 of the vane 34, respectively, while the rotor 30 is being further rotated.

Referring to Fig. 8 (b), the first and second suction grooves 261 and 263 are placed on the inclines 342 and 346 of the vane 34, respectively, and the first and second discharge grooves 262 and 264 are placed on the two leading ends 341 and 345, respectively. At this time, the first space 11 and the second subspace 142 of the fourth space 14 communicate with each other through the first suction groove 261, and the third space 13 and the second subspace 122 of the second space 12 communicate with each other through the second suction groove 263. The entire length of the first discharge groove 262 is connected with the first subspace 121 of the second space 12, and the whole length of the second discharge groove 264 is connected with the first subspace 141 of the fourth space 14. If the rotor 30 is further rotated in such a state, the second subspaces 142 and 122 are increased. Accordingly, fluid is sucked through the first and second suction ports 2611 and 2631. The sucked fluid is introduced into the two increased subspaces 142 and 122. At the same time, the two subspaces 121 and 141 with which the first and second discharge grooves 262 and 264 are connected are decreased. Accordingly, the fluid in the two subspaces 121 and 141 is discharged through the first and second discharge ports 2621 and 2641. Fig. 8 (c) shows a state where the first and second linear moving objects 50 and 60 reach the middle of the two

leading ends 341 and 345 of the vane 34, respectively, after the rotor 30 is further rotated.

Referring to Fig. 8 (c), the first suction groove 261 and second discharge groove 264 are placed on the leading end 341, while the second suction groove 263 and first discharge groove 262 are placed on the leading end 345. At this time, the whole length of the first suction groove 261 is connected with the second subspace 142 of the fourth space 14, the entire length of the first discharge groove 262 is connected with the first subspace 121 of the second space 12, the entire length of the second suction groove 263 is connected with the second subspace 122 of the second space 12, and the entire length of the second discharge groove 264 is connected with the first subspace 141 of the fourth space 14. If the rotor 30 is further rotated in such a state, the subspaces 142 and 122 are increased, and fluid is accordingly sucked through the first and second suction ports 2611 and 2631. The sucked fluid is introduced into the two increased subspaces 142 and 122. At the same time, the subspaces 121 and 141 are decreased, and the fluid in the two subspaces 121 and 141 is discharged through the first and second discharge ports 2621 and 2641. Since the first and second suction grooves 261 and 263 and the first and second discharge grooves 262 and 264 are simultaneously placed on the leading ends 341 and 345, the suction grooves 261 and 263 do not communicate with the discharge grooves 262 and 264. Therefore, a case where the suction grooves 261 and 263 are connected with the discharge grooves 262 and 264 does not occur. Accordingly, an additional check valve (often referred to as a "discharge valve") for preventing the reverse flow of fluid is not needed. Fig. 8 (d) shows a state where the first and second linear moving objects 50 and 60 reach ending points of the leading ends 341 and 345 of the vane 34 in an angular direction, respectively, after the rotor 30 is further rotated.

Referring to Fig. 8 (d), the first and second suction grooves 261 and 263 are placed on the two leading ends 341 and 345 of the vane 34, respectively, and the first and second discharge grooves 262 and 264 are placed on the inclines 344 and 348 of the vane 34, respectively. At this time, the entire length of the first suction groove 261 is connected with the second subspace 142 of the fourth space 14, and the whole length of

the second suction groove 263 is connected with the second subspace 122 of the second space 12. Further, the first space 11 and the first subspace 121 of the second space 12 communicate with each other through the first discharge groove 262, and the third space 13 and the first subspace 141 of the fourth space 14 communicate with each other through the second discharge groove 264. If the rotor 30 is further rotated in such a state, the subspaces 142 and 122 are increased, and fluid is accordingly sucked through the first and second suction ports 2611 and 2631. The sucked fluid is introduced into the two increased subspaces 142 and 122. At the same time, the space 11 and subspace 121 communicating with each other through the first discharge groove 262 and the space 13 and subspace 141 communicating with each other through the second discharge groove 264 are decreased, and the fluid therein is accordingly discharged through the first and second discharge ports 2621 and 2641. As the rotor 30 is continuously rotated, the aforementioned process is repeated in such a manner that fluid is continuously sucked through the two suction ports 2611 and 2631 and discharged through the two discharge ports 2621 and 2641. At this time, since the two spaces separated by the vane 34 are connected with each other through the first and second suction grooves 261 and 263 and the first and second discharge grooves 262 and 264, a substantially constant amount of fluid can be always sucked and discharged and thus pulsation can be minimized. Further, since the suction and discharge ports are disposed to be substantially symmetrical with each other, rotating balance is improved. Accordingly, noise and vibration are reduced.

Referring to Figs. 1, 2 and 4, high-pressure fluid at the discharge side in the rotating chamber 23 is supplied into the first and second pressing chambers 201 and 202 through the first and second passage holes 76, 78 and 86, 88 of the first and second pressing plates 70 and 80, respectively. Further, the high-pressure fluid causes the first and second pressing plates 70 and 80 to be brought into close contact with the rotor 30 so as to prevent the fluid from leaking out.

Due to the aforementioned operation of the main body 19, the discharged fluid is introduced into the pressure-regulating device 90 through the first and second discharge tubes 16 and 18. Referring to Fig. 3, the moving member 92 of the discharge

amount regulating unit 91 of the pressure regulating device 90 is pushed down at the lowermost position by means of a force of the elastic member 93. In such a state, the first and second inlets 9041 and 9042 and the first and second outlets 9043 and 9044 are closed by the opening/closing portion 921 of the moving member 92. Therefore, since the fluid discharged from the main body 19 through the first and second discharge tubes 16 and 18 is discharged through the discharge passage 150 via the second and fourth passages 102 and 104, the amount of discharge fluid becomes 100%. Further, the moving member 97 of the compressing unit 96 is in a state where it is slightly pushed upward by means of the fluid pressure in the discharge passage 150.

If the fluid pressure in the discharge passage 150 is increased in such a state, the moving member 92 of the discharge amount regulating unit 91 is moved upward against the force of the elastic member 93 due to the increased fluid pressure, as shown in Fig. 9. Referring to Fig. 9, the opening/closing portion 921 of the moving member 92 of the discharge amount regulating unit 91 is positioned to allow the first inlet and outlet 9041 and 9043 to be opened and the second inlet and outlet 9042 and 9044 to be closed. Thus, since the fluid discharged from the main body 19 through the first discharge tube 16 is discharged through the return passage 160 connected to the low-pressure side and only the fluid discharged from the main body 19 through the second discharge tube 18 is discharged through the discharge passage 150, the amount of discharge fluid becomes 50%. At this time, the first check valve 94 can prevent the high-pressure fluid in the discharge passage 150 from flowing in a reverse direction.

If the fluid pressure in the discharge passage 150 is higher than a state shown in Fig. 9, the moving member 92 of the discharge amount regulating unit 91 is moved further upward as shown in Fig. 10. Referring to Fig. 10, the opening/closing portion 921 of the moving member 92 of the discharge amount regulating unit 91 is positioned to allow the first and second inlets 9041 and 9042 and the first and second outlets 9043 and 9044 to be opened. Thus, since all the fluid discharged from the main body 19 through the first and second outlets 9043 and 9044 is discharged through the return passage 160 the amount of discharge fluid becomes 0%. At this time, the first and second check valves 94 and 95 can prevent the high-pressure fluid in the discharge

passage 150 from flowing backward into the first and second discharge tubes 16 and 18.

If the fluid pressure is lowered in such a state shown in Fig. 9 or 10, the moving member 92 of the discharge amount regulating unit 91 is pushed and moved by the elastic member 93 to deliver the fluid discharged through the first or second discharge tube 16 or 18 into the discharge passage 150 such that the amount of discharge fluid can be increased. At this time, the moving member 97 of the compressing unit 96 is pushed downward by means of the elastic member 98 and delivers the fluid remaining in the second pressure supply passage 152 into the discharge passage 150. Accordingly, the lowered pressure in the discharge passage 150 is recovered up to a certain point.

Figs. 11 to 14 show a second embodiment of the present invention. Referring to Figs. 11 and 12, a fluid pump 10a includes a main body 19a and a pressure-regulating device 90a. The main body 19a includes a housing 20a, a rotor 30a, a rotating shaft 40a and a linear moving object 50a. A direction in which the rotating shaft 40a extends becomes a rotating axis 100a. The housing 20a includes a cylindrical body portion 21a and a wing portion 28a. The body portion 21a includes first and second circular end walls 22a and 24a, and a side wall 26a connecting the two end walls 22a and 24a. A cylindrical rotating chamber 23a in which the rotor 30a is accommodated is provided in the body portion 21a. The rotating chamber 23a is defined by first and second opposite circular wall surfaces 231a and 232a and a third circular wall surface 233a connecting the first and second wall surfaces 231a and 232a. The first and second wall surfaces 231a and 232a are inner surfaces of the first and second end walls 231a and 232a of the body portion 21a, while the third wall surface 233a is an inner surface of the side wall 26a of the body portion 21a. The leading end 341a of a vane 34a to be explained later is brought into close contact with the first wall surface 231a in such a manner that it can be slid while coming into surface contact with the first wall surface, whereas the trailing end 343a of the vane 34 are brought into close contact with the second wall surface 232a in such a manner that it can be slid while coming into surface contact with the second wall surface. The radial tip of the vane 34 about the rotating axis 100a of the vane 34a, which will be explained later, is slidably brought into

close contact with the third wall surface 233a. The rotating shaft 40a passes through the centers of the two end walls 22a and 24a of the body portion 21a. The rotating shaft 40a is rotatably supported by bearings 42a and 44a installed at the centers of the two end walls 22a and 24a, respectively. The rotating shaft 40a extends along the rotating axis 100a beyond the first end wall 22a and is rotatably connected to a driving unit (not shown).

Referring to Figs. 11 and 12, a suction groove 261a and a discharge groove 262a, which extend straightly to the first and second wall surfaces 231a and 232a in an extending (longitudinal) direction of the rotating axis 100a, are formed on the third wall surface 233a of the rotating chamber 23a adjacent to each other. First and second blocking walls 54a and 56a of the linear moving object 50a to be explained later are positioned between the suction and discharge grooves 261a and 262a. A suction port 2611a and a discharge port 2621a are provided at the centers of the suction and discharge grooves 262a and 264a, respectively. A suction tube 15a and a discharge tube 17a are connected to the suction and discharge ports 2611a and 2621a, respectively. The configuration of the wind portion 28a is the same as that of the first wing portion 28 described in the first embodiment, except that only a single wing portion 28 is employed in this second embodiment. Thus, a detailed description thereof will be omitted herein.

Referring again to Figs. 11 and 12, the rotor 30a is placed in the rotating chamber 23a within the housing 20a and includes a cylindrical hub 32a coupled to the rotating shaft 40a and the vane 34a protruding from the hub 32a. Opposite ends of the hub 32a are slidably brought into close contact with the first and second wall surfaces 231a and 232a in the rotating chamber 23a, respectively. The vane 34a takes the shape of a wall protruding from an outer circumferential surface 321a of the hub 32a in a radial direction of the rotating axis 100a and surrounds the outer circumferential surface of the hub 32a such that both side surfaces 340a and 349a of the vane face the first and second wall surfaces 231a and 232a of the rotating chamber 23a, respectively. Herein, one of the side surfaces 340a and 349a facing the first wall surface 231a of the rotating chamber 23a is referred to as the first surface 340a, whereas the other of the two surfaces facing the second wall surface 232a of the rotating chamber 23a is referred to

as the second surface 349a.

Referring to Figs. 11 and 12 together with Fig. 13 (a) in which a rotor 30a is unrolled and shown, the vane 34a includes the flat leading end 341a which has a predetermined width (an angular width) perpendicular to the rotating axis 100a such that it can be brought into surface contact with the first wall surface 231a of the rotating chamber 23a, the flat trailing end 343a which has a predetermined width (an angular width) perpendicular to the rotating axis 100a such that it can be brought into surface contact with the second wall surface 232a of the rotating chamber 23a, and two inclines 342a and 344a which are inclined with respect to the rotating axis 100a and connect the leading and trailing ends 341a and 342a. The radial tip of the vane 34a about the rotating axis 100a is slidably brought into close contact with the third wall surface 233a of the rotating chamber 23a. Due to such a configuration of the vane 34a, the space defined between the outer circumferential surface 321a of the hub 32a of the rotor 30a and the third wall surface 233a of the rotating chamber 23a is divided into a first space 11a formed by the first wall surface 231a of the rotating chamber 23a and the first surface 340a of the vane 34a, and a second space 12a formed by the second wall surface 232a of the rotating chamber 23a and the second surface 349a of the vane 34a. The leading and trailing ends 341a and 343a are arranged to be diametrically opposite to each other about the rotating axis 100a. The width of the radial tips (angular width) of the leading and trailing ends 341a and 343a is formed to be greater than the maximum angular distance between the suction and discharge grooves 261a and 262a (i.e., an angular distance from the farthest end of the suction groove to the farthest end of the discharge groove) (See Fig. 12 (c)). The two inclines 342a and 344a are inclined with respect to the rotating axis 100a and smoothly connect the leading and trailing ends 341a and 343a. That is, the vane 34a is configured in such a manner that the leading end 341a, incline 342a, trailing end 343a and incline 344a are sequentially connected to each other and disposed on the outer circumferential surface 321a of the hub 32a across its one revolution.

A detailed description on the linear moving object 50a will be omitted herein, because it is the same as the first linear moving object 50 in view of their configuration.

As shown in Fig. 13 (a), when the linear moving object 50a is positioned at the incline 342a of the vane 34a (or when the object is positioned at the other incline 344a), the first blocking wall 54a divides the first space 11a into first and second subspaces 111a and 112a and blocks the two subspaces 111a and 112a. Further, the second blocking wall 56a divides the second space 12a into first and second subspaces 121a and 122a and blocks the two subspaces 121a and 122a. On the other hand, as shown in Fig. 13 (b) to (d), when the linear moving object 50a is positioned at the leading end 341a of the vane 34a, the first space 11a is not divided by the first blocking wall 54a and remains a single space, but the second space 12a is still in a state where it is divided into two subspaces 121a and 122a by means of the second blocking wall 56a. Although not shown in the figure, it can be easily understood by those skilled in the art that when the linear moving object 50a is positioned at the trailing end 343a of the vane 34a, only the first space 11a is divided into two subspaces by means of the first blocking wall 54a.

Referring to Fig. 12, the pressure-regulating device 90a includes a discharge amount regulating unit 91a and a compressing unit 96a which are provided in a block 900a. The discharge amount regulating unit 91a includes a moving member 92a, an elastic member 93a, and a check valve 94a. The moving member 92a and elastic member 93a are received in a first receiving space 901a. An inlet 9041a connected to a first passage 101a to be explained later is formed in the middle of the side wall 904a. The side wall 904a is provided with an outlet 9043a, which is connected to a third passage 105a to be explained later, at a position opposite to the inlet 9041a. A discharge tube 16a extending from the main body 19a of the fluid pump 10a is branched off into the first and second passages 101a and 102a. The first passage 101a communicates with the first receiving space 901a through the inlet 9041a, and the second passage 102a is connected with the discharge passage 150a. The check valve 94a is provided on the second passage 102a to prevent fluid from flowing in a reverse direction. Although the third passage 105a connected with the outlet 9043a of the first receiving space 901a is not shown, it is connected to a return passage 160a communicating with a low-pressure side such as a storage tank. The other configuration of the pressure-regulating device 90a is the same as that of the pressure-

regulating device 90 according to the first embodiment of the present invention, and thus, a detailed description thereof will be omitted herein.

Hereinafter, the operation of the second embodiment of the present invention will be described in detail with reference to Fig. 13 (a) to (d) and Figs. 12 and 14. First, the operation of the main body 19a will be described with reference to Fig. 13 (a) to (d). Fig. 13 (a) to (d) shows the rotor 30a in a state where it is unrolled. If the rotating shaft 40a is rotated clockwise by means of the driving unit (not shown) as shown in Fig. 11, the rotor 30a is also rotated clockwise. This rotation corresponds to a leftward linear motion of the unrolled rotor 30a shown in Fig. 13 (a) to (d). In Fig. 13 (a), the linear moving object 50a is placed on the incline 342a of the vane 34a. Referring to Fig. 13 (a), the second subspaces 112a and 122a of the first and second spaces 11a and 12a communicate with each other through the suction groove 261a, and the first subspaces 111a and 121a of the first and second spaces 11 and 12 communicate with each other through the discharge groove 262a. If the rotor 30 is rotated in such a state, the two subspaces 112a and 122a communicating with each other through the suction groove 261a are increased, and fluid is thus sucked through the suction port 2611a connected with the suction tube (15a, See Fig. 11). The sucked fluid is introduced into the second subspaces 112a and 122a through the suction groove 261a. At the same time, the first subspaces 111a and 121a communicating with each other through the discharge groove 262a are decreased, and the fluid in the two subspaces 111a and 121a is thus discharged to the discharge port 2621a through the discharge groove 262a. Fig. 13 (b) shows a state where the linear moving object 50a reaches the leading end 341a of the vane 34a while the rotor 30a is being further rotated.

Referring to Fig. 13 (b), the suction groove 261a is placed on the incline 342a of the vane 34a and the discharge groove 262a is placed on the leading end 341a. At this time, the first space 11a and the second subspace 122a of the second space 12a communicate with each other through the suction groove 261a. The whole length of the discharge groove 262a is connected with the first subspace 121a of the second space 12a. If the rotor 30a is further rotated in such a state, only the second subspace 122a of the second space 12a is increased, and fluid is sucked through the suction port 2611a

connected with the suction tube (15a, See Fig. 12). The sucked fluid is introduced into the increased subspace 122a through the suction groove 261a. At the same time, the first subspace 121a of the second space 12a in which the discharge groove 262a is positioned is decreased, and the fluid in the first subspace 121a is thus discharged through the discharge port 2621a connected to the discharge tube (17a, See Fig. 12). Fig. 13 (c) shows a state where the linear moving object 50a reaches the middle of the leading end 341a of the vane 34a after the rotor 30a is further rotated.

Referring to Fig. 13 (c), the suction groove 261a and discharge groove 262a are placed on the leading end 341a of the vane 34a. The entire length of the suction groove 261a is connected with the second subspace 122a of the second space 12a, while the entire length of the discharge groove 262a is connected with the first subspace 121a of the second space 12a. If the rotor 30a is further rotated in such a state, the second subspace 122a of the second space 12a is increased, and fluid is thus sucked through the suction port 2611a connected to the suction tube (15a, See Fig. 12). The sucked fluid is introduced into the increased subspace 122a of the second space 12a. At the same time, the first subspace 121a connected to the discharge groove 262a is decreased, and the fluid in the subspace 121a is thus discharged through the discharge port 2621a connected to the discharge tube (16a, See Fig. 12). Since the suction groove 261a and discharge groove 262a are simultaneously placed on the leading end 341a, the suction groove 261a and the discharge groove 262a do not communicate with each other. Therefore, a case where the suction and discharge ports 2611a and 2621a are connected with each other through the first space 11a does not occur, and thus, any losses can be minimized. Therefore, this allows the efficiency of the pump to be improved and also prevents the reverse flow of fluid due to communication between the suction and discharge ports. Accordingly, an additional check valve (often referred to as a "discharge valve") is not needed. Fig. 13 (d) shows a state where the linear moving object 50a reaches the ending point of the leading end 341a of the vane 34a in an angular direction after the rotor 30a is further rotated.

Referring to Fig. 13 (d), the suction groove 261a is placed on the leading end 341a of the vane 34a and the discharge groove 262a is placed on the incline 344a of the

vane 34a. The whole length of the suction groove 261a is connected with the second subspace 122a of the second space 12a. Further, the first space 11a and the first subspace 121a of the second space 12a communicate with each other through the discharge groove 262a. If the rotor 30a is further rotated in such a state, the subspace 122a connected to the suction groove 262a is increased, and fluid is thus sucked through the suction port 2611a connected to the suction tube (15a, See Fig. 12). The sucked fluid is then introduced into the subspace 122a of the second space 12a. At the same time, the space 11a and subspace 121a of the second space 12a communicating with each other through the discharge groove 262a are decreased, and the fluid therein is thus discharged through the discharge port 2621a connected to the discharge tube (16a, See Fig. 12).

As the rotor 30a is continuously rotated, the aforementioned process is repeated in such a manner that fluid is continuously sucked through the suction port 2611a and discharged through the discharge port 2621a.

Due to the aforementioned operation of the main body 19a, the discharged fluid is then introduced into the pressure-regulating device 90a through the discharge tube 16a. Referring to Fig. 12, the moving member 92a of the discharge amount regulating unit 91a of the pressure regulating device 90a is pushed down at a position closest to the discharge passage 150a by means of a force of the elastic member 93a. In such a state, the inlet and outlet 9041a and 9043 9043a are closed by an opening/closing portion 921a of the moving member 92a. Therefore, since the fluid discharged from the main body 19a through the discharge tube 16a is discharged through the discharge passage 150a via the second passage 102a, the amount of discharge fluid becomes 100%. Further, the moving member 92a of the compressing unit 96a is in a state where it is slightly pushed away from the discharge passage 150a by means of the fluid pressure in the discharge passage 150a. If the fluid pressure in the discharge passage 150a is increased in such a state, the moving member 92a of the discharge amount regulating unit 91a is moved away from the discharge passage 150a against the force of the elastic member 93a due to the increased fluid pressure, as shown in Fig. 14. Referring to Fig. 14, the opening/closing portion 921a of the moving member 92a of the discharge amount

regulating unit 91a is positioned to allow the inlet and outlet 9041a and 9043a to be opened. Thus, since the fluid discharged from the main body 19a through the discharge tube 16a is discharged through the return passage 160a connected to the low-pressure side, the amount of discharge fluid becomes 0%. At this time, the check valve 94a can prevent the high-pressure fluid in the discharge passage 150a from flowing in a reverse direction. If the fluid pressure in the discharge passage 150a is lowered in a state shown in Fig. 14, the moving member 92a of the discharge amount regulating unit 91a is pushed and moved by the elastic member 93a to deliver the fluid discharged through the discharge tube 16a into the discharge passage 150a such that the amount of discharge fluid can be increased. At this time, the moving member 97a of the compressing unit 96a is pushed away by means of the elastic member 98a and delivers the fluid remaining in a pressure supply passage 152a into the discharge passage 150a. Accordingly, the lowered pressure in the discharge passage 150a is recovered up to a certain point.

Although the main bodies 19 and 19a have been described as being used as pumps in the previous two embodiments, the present invention is not limited thereto. It will be understood by those skilled in the art that the main bodies 19 and 19a are constructed to be used as fluid motors. In case of the main body 19 of the first embodiment, when the high-pressure fluid is introduced into the rotating chamber 23 through the first and second suction ports 2611 and 2631, the rotor 30 rotates and the introduced fluid is then discharged through the first and second discharge ports 2621 and 2641.

In the previous two embodiments, the width (angular width) of the edge of each contact portion of the vane has been described as being larger than the maximum angular distance between adjacent two grooves. However, the present invention is not limited thereto. The width of the edge of each contact portion of the vane may be formed to be smaller than the maximum angular distance between adjacent two grooves. If necessary, each contact portion may be formed to be brought into line contact with the first or second wall surface of the rotating chamber rather than the surface contact. In this case, it will be understood by those skilled in the art that the pump may be

constructed by mounting a check valve for preventing backflow of the fluid within each discharge tube.

Figs. 15 to 17 are views of a main body of a fluid pump according to a third embodiment of the present invention. Referring to Figs. 15 to 17, a suction tube 15b is branched off into two passages which in turn are connected to sides of wing portions 28 of two end walls 22b and 24b of the housing 20b. A discharge tube 16b is also branched off into two passages which in turn are connected to sides of the guide portion 28b of the two end walls 22b and 24b of the housing 20b. The housing 20b is the same as the housing 20b of the fluid pump of the aforementioned second embodiment in their constitutions except that the housing 20b does not have the suction groove 261a, the discharge groove 262a and the passage holes 282a at both ends of the guide portion 28a. Therefore, a detailed description thereof will be omitted.

Referring to Figs. 16 and 17, a linear moving object 50b has a structure substantially similar to that of the linear moving object 50 of the first embodiment shown in Fig. 5. The linear moving object 50b includes two contact members 58b that are slidably fitted at opposite positions in two blocking walls 54b and 56b, respectively, and slide against a vane (not shown). Each of the blocking walls 54b and 56b is provided with a receiving groove 511b into which the contact member 58 is fitted, a passage hole 512b communicating with the receiving groove 511b, and a connecting groove 59b . The receiving grooves 511b are open while facing each other at opposite ends of the two blocking walls 54b and 56b and also open upwardly at upper ends 541b and 561b of the two blocking walls 54b and 56b. The passage holes 512b are formed on discharge sides of the blocking walls 54b and 56b to communicate with the respective receiving grooves 511b. A high-pressure fluid on the discharge sides is supplied to the receiving grooves 511b through the passage holes 512b. The connecting grooves 59b are formed on suction sides of the blocking walls 54b and 56b. Each connecting groove 59b connects both ends of each of the blocking walls 54b and 56b. A low-pressure fluid on the suction sides are supplied to guide passages 281b through the connecting grooves 59b to cause the linear moving object 50b to move smoothly.

Opposite one end of each of the contact members 58b fitted into the receiving grooves 511b is tapered toward a tip thereof to form a contact end 542b or 562b that is brought into close contact with the vane (not shown). The other side of each of the contact members 58b has upper and lower extensions to provide a space capable of receiving the high-pressure fluid introduced through the relevant passage hole 512b of each of the blocking walls 54b and 56b. The high-pressure fluid introduced through the passage holes 512b of the blocking walls 54b and 56b urges the contact members 58b so that the contact ends 542b and 562b of the contact members is slidably brought into close contact with the vane (not shown). Portions of the contact members 58b connected to the upper ends of the blocking walls 54b and 56b also taper toward tips thereof to be slidably brought into close contact with the outer circumferential surface of a hub (not shown). Since the other operations and effects are the same as the second embodiment shown in Fig. 11, a detailed description thereof will be omitted.

With the structures of the present invention, all the aforementioned objects of the present invention can be achieved. Specifically, since the rotor is not eccentric, there is no vibration and bearings are not easily damaged. Further, since the vane does not have a structure in which it moves in and out of the rotor, its structure is simplified. Particularly, since all fluids in both spaces separated by the vane are discharged contrary to the pump disclosed in Korean Patent No. 315954, the amount of discharge fluid is doubled. Further, since the width of a compression area is kept constant, a constant amount of fluid per unit time is discharged, thereby minimizing pulsation and providing stable discharge pressure. Moreover, in case of the structure in which the discharge valve (check valve) is not needed, the conversion thereof into a fluid motor can be easily performed.

Although the present invention has been described and illustrated in connection with the exemplary embodiments of the present invention, it will be understood that various changes, modifications and additions can be made thereto without departing from the sprit and scope of the present invention.